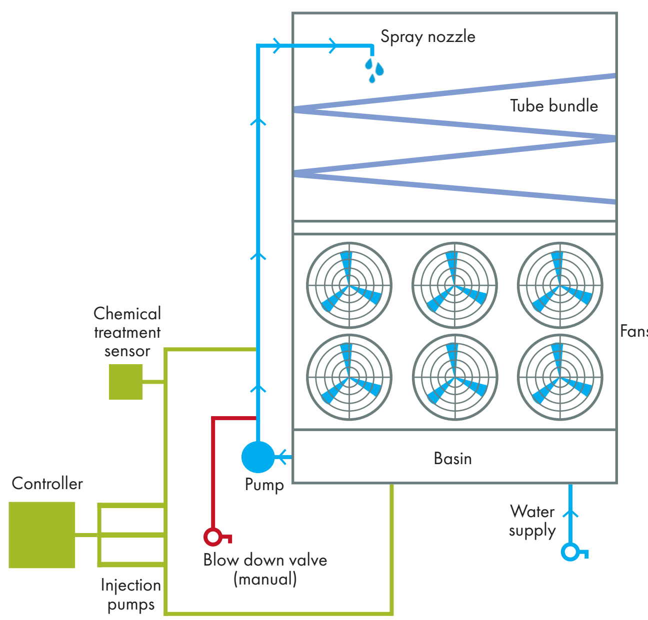
CONDENSER REMOTE SUMP DESIGN AT HALF THE COST

Posted in: Food & Beverage | April 14, 2020

In the industrial refrigeration industry, evaporative condensers are the primary method to reject heat into the atmosphere. In this method, refrigerant enters a serpentine tube bundle as a superheated vapor and travels through the tubes, where it condenses into a liquid. Water is pumped to the top of the unit then sprayed over the tube bundle. At the same time, fans move air up through the tube bundle. Heat is rejected into the atmosphere via the evaporating effect of water and the movement of air over the serpentine tube bundle. There are two primary methods of delivering the water to the tube bundle: integral sump or remote sump.

The integral sump design involves pumping water from a basin up to the spray nozzles on top of the tube bundle. This method is energy efficient but has several complications. For instance, each condenser cell needs its own water makeup, controller, injection pumps and blow down control.



Because individual water treatment systems need to be connected to each cell, integral sump condensers often have a manual blow down valve from the pump outlet directly to the drain. This can cause issues as there is no automated control of these valves, and they're often not set properly. When the valve opens too far, water and chemicals are wasted. When the valve is not open far enough, the mineral content increases, and the chemical treatment does not provide the proper protection.

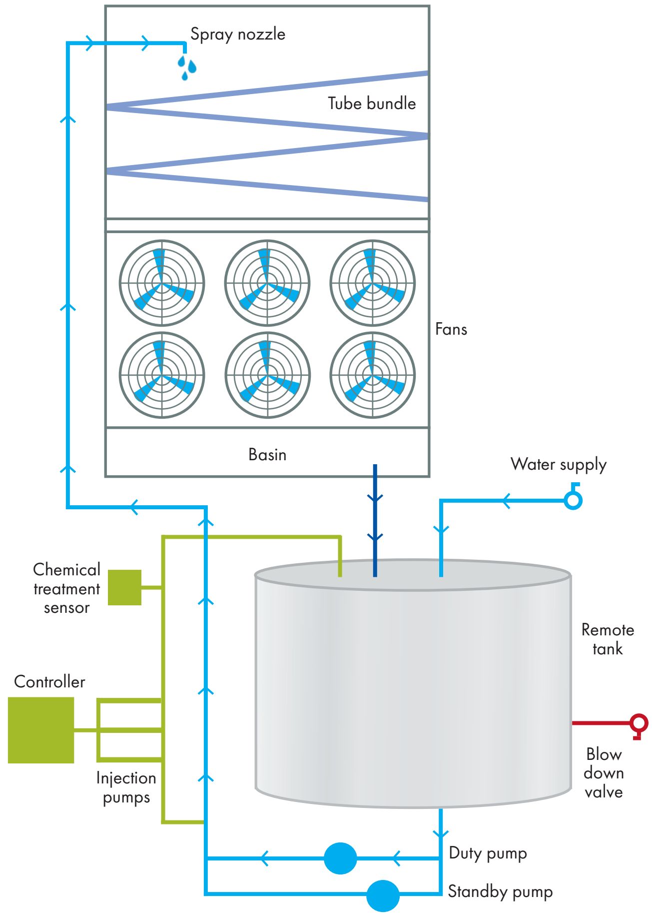
In addition, integral sump units need electric heaters to prevent freezing during winter downtimes. The heater system controls also need a level switch and thermostats. In the northern climates, condenser cells are often drained in the winter months, so the condenser capacity more closely matches the system load. The treated water in the basin is then drained to the sewer. Often all this equipment is in disrepair and money is wasted on chemicals and excess water usage.

While the integral sump design maintains the mass of water in the condenser basin, the remote sump design maintains the mass of water in a remote tank inside the engine room. These systems are more popular in the northern climates where there is more risk of freezing.

In the remote sump design, water is pumped from the tank inside the engine room up to the spray nozzles on top of the tube bundle. The water flows over the tubes, through the basin, and then back to the tank. The support equipment is simplified; there is only one water makeup valve, one chemical treatment controller, one automated blow down valve and there is no heater system required.

However, there are some downsides to this design. A remote tank and pumps, along with associated larger piping, are more expensive to install and increases energy usage as the water is required to be lifted higher than an integral design.

The energy cost between the two designs varies greatly. The table below illustrates the operational cost differences for a 1,000 TR system operating 8,500 hours per year at $0.10/Kwh.



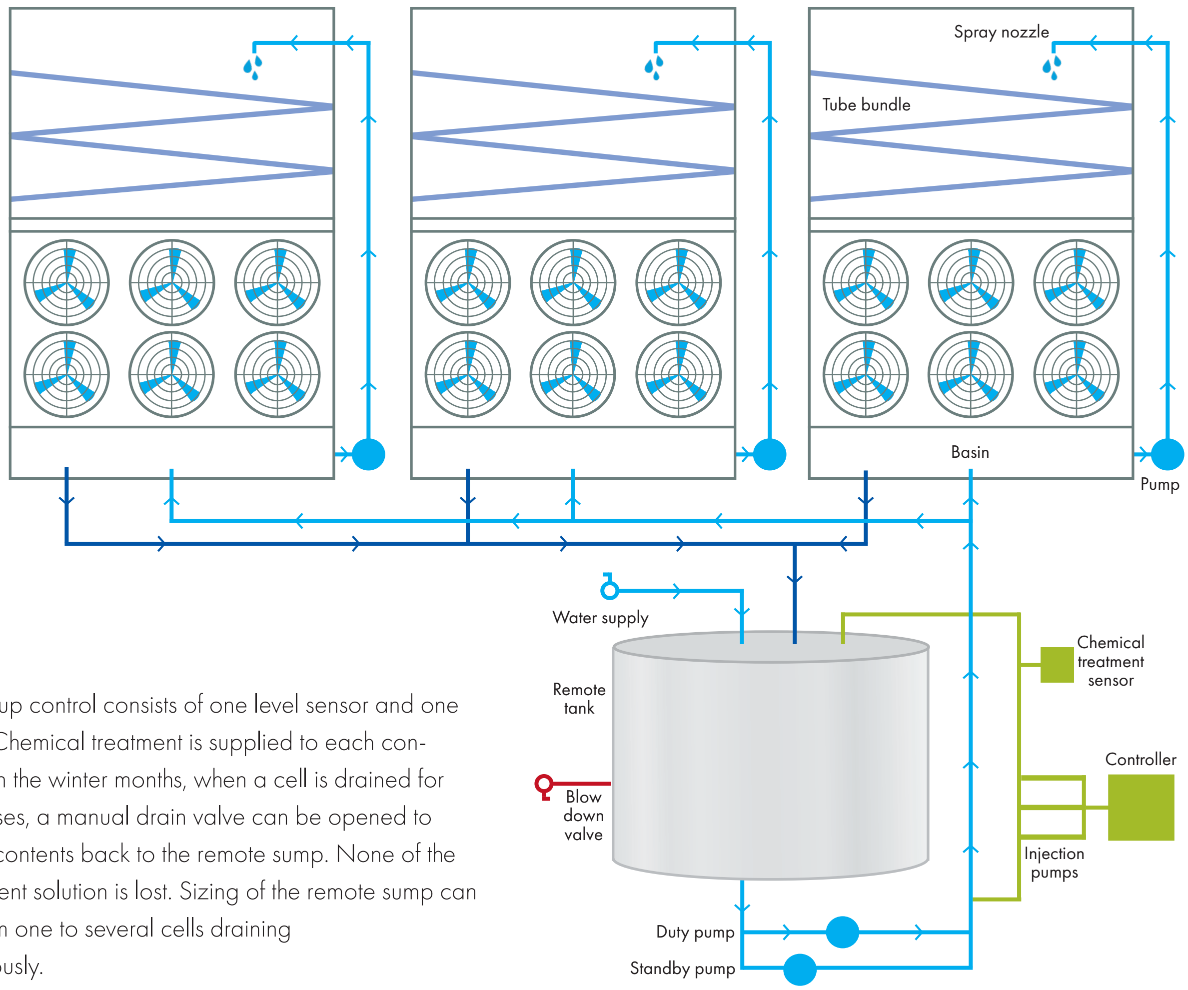
	Integral Sump Pumps			Remote Sump Pumps			Total
	GPM	TDH, ft	BHP	GPM	TDH, ft	BHP	BHP
Integral Sump Design	1860	~15	15				15
Remote Sump Design				1860	50	29.4	29.4
				BHP Difference			14.4
				Yearly difference in operation cost ($)			$11,008

As seen above, the remote sump design is nearly twice the operating cost of the integral sump per year.

The engineers at Mead & Hunt have used a hybrid approach that combines the methods to give our clients the best of both options. We call it "Integral Sump Remote Fed."

Within this hybrid method, the condensers are ordered as an integral sump without the water level controls or the heater and associated controls. We make one addition: installing a return water standpipe in the condenser basin.

The premise of the design is that each condenser cell operates like an integral sump design; however, each cell is fed with treated water from a remote sump at three times the evaporation rate. For every one part that is evaporated, two parts are returned to the remote sump. The remote sump has a duty and standby pump to feed the condenser cells. This system only requires one chemical treatment controller, one blow down valve and one set of chemical injection pumps.



The water makeup control consists of one level sensor and one makeup valve. Chemical treatment is supplied to each condenser evenly. In the winter months, when a cell is drained for capacity purposes, a manual drain valve can be opened to drain the basin contents back to the remote sump. None of the chemical treatment solution is lost. Sizing of the remote sump can be adjusted from one to several cells draining back simultaneously.

	Integral Sump Pumps			Remote Sump Pumps			Feed Pump			Total
	GPM	TDH, ft	BHP	GPM	TDH, ft	BHP	GPM	TDH, ft	BHP	BHP
Integral Sump Design	1860	~15	15							15
Remote Sump Design				1860	50	29.4				29.4
Integral Sump Remote Fed	1860		15				90	45	1.45	16.45

The table above compares the energy costs of the Integral Sump Remote Fed design to the traditional designs. The energy cost premium of the Integral Sump Remote Fed design is nearly negligible: less than $1,000 per year over the standard integral sump design. The Integral Sump Remote Fed option gives the owner the best of both design options, with slightly higher operating cost than an integral sump design and the single-control simplicity of a remote sump design. This design is both capital and operational cost efficient.

About the Author

Ryan Schuetz is responsible for leading the engineering team to ingrain the values of long term relationships, effective execution and collaborative solutions both internally and externally with clients. Ryan's other responsibilities include leading major projects and training for the engineering team. He is recognized as one of the ammonia refrigeration industry leading engineers and is involved in many evaluations of existing systems for improved safety, performance and efficiency.